Table of Possible Analytes to be Assessed in the GuLF STUDY, with Reported Human Health Effects

Agent	Source	Type of job	Number of Workers	Human health effects*
VOCs (Volatile Organic Compounds):				
Benzene	Oil	Rig workers, ship crews in hot zone, fuel distributors, barge workers	Moderate	1. Benzene is an irritant to skin & may cause erythema, vesiculation, & dry & scaly dermatitis. 2. A severe eye and moderate skin irritant. 3. Acute exposure to high concentrations of benzene in air results in neurological toxicity; may sensitize the myocardium to endogenous catecholamines. Acute ingestion - gastrointestinal and neurological toxicity. Chronic exposure - primarily hematotoxicity, including aplastic anemia, pancytopenia, or any combination of anemia, leukopenia, and thrombocytopenia, with an increased risk of leukemia. Clinical effects: acute neurological toxicity - headache, dizziness, drowsiness, confusion, tremors, and loss of consciousness. Exposure to high concentrations may have effects on multiple organ systems. Sudden deaths occurring below anesthetic concentrations of benzene are apparently due to cardiac dysrhythmias. Ingestion - nausea, vomiting, and abdominal pain as well as neurological toxicity. Chronic hematological effects include anemia, thrombocytopenia, leukopenia, pancytopenia, chromosomal abberations, and leukemia. Dermal exposure may cause skin irritation. 4. IARC Group 1: The chemical is carcinogenic to humans. 5. ACGIH A1; Confirmed human carcinogen
Overall Reference: HSDB® Hazardous Substances Data Bank BENZENE 71432 Section 0 Administrative Information Hazardous Substances Databank Number: 35 Last Revision Date 20050624 Review Date Reviewed by SRP on 1/29/2000 1. Clayton, G.D., F.E. Clayton (eds.) Patty's Industrial Hygiene and Toxicology. Volumes 2A, 2B, 2C, 2D, 2E, 2F: Toxicology. 4th ed. New York, NY: John Wiley & Sons Inc., 19931994., p. 1308 2. Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 13. New York, NY: Van Nostrand Reinhold, 1996., p. 334 3. International Programme on Chemical Safety; Poisons Information Monograph: Benzene (PIM 063) (1999) Available from, as of October 24, 2005: http://www.inchem.org/pages/pims.html 4. IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multi-volume work)., p. S7 120 (1987) 5. ACGIH - American Conference of Governmental Industrial Hygienists TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH, 2008, p. 13				
Toluene	Oil	Rig workers, ship crews in hot zone, fuel	Moderate	1. Vapors irritate eyes and upper respiratory tract; Cause dizziness, headache, anesthesia, and respiratory arrest. Liquid irritates eyes. If aspirated, causes coughing, gagging, distress, and rapidly developing pulmonary edema. If ingested causes vomiting, griping, diarrhea, and depressed respiration. Kidney and liver damage may follow ingestion.

Agent	Source	Type of job	Number of Workers	Human health effects*
		distributors, barge workers		2. A human eye irritant. An experimental skin and severe eye irritant. 3. Toxicities associated with toluene: CNS depression, syncope, coma, cardiac arrhythmias and sudden death, ataxia, convulsions, rhabdomyolysis, increased creatine phosphokinase, abdominal pain, nausea, vomiting, hematemesis, peripheral neuropathy, paresthesias, encephalopathy, optic neuropathy, cerebella ataxia, distal renal tubular acidosis, hyperchloremia, hypokalemia, azotemia, hypophosphatemia, hematuria, proteinuria, pyruria, normalities, decreased cognitive function, fatal overdose. 4. Among 61 painters inhaling 100-1100 ppm toluene for 2 wk to 5 yr, depressed erythrocyte counts with elevated hemoglobin, mean corpuscular volumes, and elevated mean corpuscular hemoglobin were … 5. Defatting of skin with subsequent danger of dryness, fissuring and secondary infection. 6. Noticeable sensation of irritation to human eyes at 300-400 ppm in air, but even at 800 ppm irritation is slight. In human volunteers exposed to concn as high as 800 ppm dilation of pupils & impairment of reaction in association with fatigue at end of 8 hr, also slight pallor of fundi. 7. Reversible effects upon liver, renal, and nervous systems. ... The nervous system appears to be the most sensitive; incoordination, ataxia, unconsciousness and eventually, death. Lower level acute exposures in man produce dizziness, exhilaration and confusion. 8. Acute poisoning may result from exposure to high concn; A CNS depressant effect is produced. Human death has resulted from exposure to 10,000 ppm. Toluene is more acutely toxic than benzene, however, severe blood disorders of the type associated with benzene are not reported. Inhalation of 200 ppm has affected the CNS in humans. 9. Women workers exposed to high air concentrations (50-150 ppm) appeared to have a higher incidence of spontaneous abortion than a similar group of women with no occupational exposure. 10. Eye and upper airway irritation occurred after a 6.5 hr exposure to an air level of 100 ppm (377 mg/cu m), and lachrymation was seen at 500 mg/cu m. Volunteers exposed to 100 ppm (377 mg/cu m) for 6 hr/day for four days suffered from subjective complaints of headache, dizziness and a sensation of intoxication. In subjects exposed to 750 mg/cu m for 8 hr, fatigue, muscular weakness, confusion, impaired coordination, enlarged pupils and accommodation disturbances were experienced; at about 3000 mg/cu m, severe fatigue, pronounced nausea, mental confusion, considerable incoordination with

Agent	Source	Type of job	Number of Workers	Human health effects*
				staggering gait and strongly affected pupillary light reflexes were observed. After exposure at the high level, muscular fatigue, nervousness and insomnia lasted for several days. Heavy accidental exposure leads to coma. 11. Humans exposed to concentrations of between 200-800 ppm may experience respiratory and ocular irritation. . . . Controlled exposure effects on volunteers were studied at concentrations ranging from 40, 60, or 100 ppm. Psychologic measurements indicated decrements in vigilance, visual perception, motor performance, and ability to carry out functions at 100 ppm. 12. Acute effects in humans following exposure to toluene: 50-100 ppm: subjective complaints (fatigue or headache), but probably no observable impairment of reaction time or coordination; 200 ppm: mild throat and eye irritation; 100-300 ppm: detectable signs of incoordination may be expected during exposure periods up to 8 hr; 400 ppm: lacrimation and irritation to the eyes and throat; 300-800 ppm: gross signs of incoordination may be expected during exposure periods up to 8 hr; 1500 ppm: probably not lethal for exposure periods of up to 8 hr; 4000 ppm: would probably cause rapid impairment of reaction time and coordination, exposures of one hr or longer might lead to CNS depression and possibly death; 10,000-30,000 ppm: onset of CNS depression within a few minutes, longer exposures may be lethal. 13. Studies of women exposed to solvents such as benzene, toluene, and xylene have shown menstrual disturbances, principally associated with abnormal bleeding. 14. The highest concentrations in air that could be tolerated for 3.5-6 hr without measurable decrements on behavioral test performance were 80 ppm to 100 ppm. A group of 95-104 workers exposed to TWA of 41-46 ppm toluene during shoemaking, printing, and audio equipment production were evaluated for symptoms and signs of exposure when compared to 130 control subjects. The incidence of health-related complaints among the toluene exposed workers was two to three times that of the controls. Dizziness was reported by about two-thirds of the toluene exposed respondents. These subjects also complained of headaches, sore throats, eye irritation, and difficulty with sleep. When the exposed subjects were divided into two groups, one with TWA exposures of less than 40 ppm and the other with exposures greater than or equal to 40 ppm, the incidence of headache and sore throat, but not dizziness, showed a dose response pattern.
Overall Reference: HSDB® Hazardous Substances Data Bank TOLUENE 108883 Section 0 Administrative Information Hazardous Substances Databank				

Agent	Source	Type of job	Number of Workers	Human health effects*
Number: 131 Last Revision Date 20060214 Review Date Reviewed by SRP on 1/29/2000 1. CHRIS U.S. Coast Guard, Department of Transportation. CHRIS Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5. 2. Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 13. New York, NY: Van Nostrand Reinhold, 1996., p. 3190 3. Ellenhorn, M.J., S. Schonwald, G. Ordog, J. Wasserberger. Ellenhorn's Medical Toxicology: Diagnosis and Treatment of Human Poisoning. 2nd ed. Baltimore, MD: Williams and Wilkins, 1997., p. 1494 4. ACGIH American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values and Biological Exposure Indices. 6th ed. Volumes I, II, III. Cincinnati, OH: ACGIH, 1991., p. 1573 5. ILO International Labour Office. Encyclopedia of Occupational Health and Safety. Volumes I and II. New York: McGrawHill Book Co., 1971., p. 1414 6. Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 927 7. Benignus VA; Neurobehav Toxicol Teratol 3 (4): 40715 (1981) 8. Cleland, J.G., G.L. Kingsbury. Multimedia Environmental Goals for Environmental Assessment. Volume 1. EPA600/7-77-136a. Research Triangle Park, NC: EPA, Nov. 1977., p. E146 9. Ellenhorn, M.J., S. Schonwald, G. Ordog, J. Wasserberger. Ellenhorn's Medical Toxicology: Diagnosis and Treatment of Human Poisoning. 2nd ed. Baltimore, MD: Williams and Wilkins, 1997., p. 166 10. IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V47 101 (1989) 11. Sullivan, J.B. Jr., G.R. Krieger (eds.). Hazardous Materials Toxicology-Clinical Principlesof Environmental Health. Baltimore, MD: Williams and Wilkins, 1992., p. 1090 12. Zenz, C., O.B. Dickerson, E.P. Horvath. Occupational Medicine. 3rd ed. St. Louis, MO., 1994, p. 724 13. Rom, W.N. (ed.). Environmental and Occupational Medicine. 2nd ed. Boston, MA: Little, Brown and Company, 1992., p. 155 14. ACGIH American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values and Biological Exposure Indices. 6th ed. Volumes I, II, III. Cincinnati, OH: ACGIH, 1991., p. 1574 15. Yin S et al; Ind Health 25: 11330 (1987) as cited in U.S. Dept Health & Human Services/Agency for Toxic Substances & Disease Registry; Toxicological Profile for Toluene (Update) p.41 (1994) ATSDR/TP93/14				
Xylenes	Oil	Rig workers, ship crews in hot zone	Moderate	1. Acute exposure to high concentrations of xylene can result in CNS effects and irritation in humans. 2. Vapor irritates eyes and mucous membranes and may cause dizziness, headache, nausea, and mental confusion. Liquid irritates eyes and mucous membranes. Swallowing or absorption through skin would cause poisoning. Prolonged exposure to skin contact may result in dermatitis. . . . Vapor irritates eyes and mucous membranes and may cause dizziness, headache, nausea, and mental confusion. Liquid irritates eyes and mucous membranes. Swallowing or absorption through skin would cause poisoning. Prolonged

Agent	Source	Type of job	Number of Workers	Human health effects*
				exposure to skin contact may result in dermatitis. 3. At high concentrations, vapor may cause severe breathing difficulties which may be delayed in onset. Repeated or prolonged exposure ... may cause a skin rash. 4. A 1993 occupational study indicates that workers exposed to xylenes (geometric mean TWA 14 ppm) reported reduced grasping power and reduced muscle power in the extremities more frequently than the unexposed controls. This effect was a neurological effect rather than a direct effect on the muscles. 5. High-level exposure to xylenes or solvents containing xylenes can induce a variety of neurological symptoms in humans ranging from dizziness, headache, nausea, difficulty in concentrating, to slurred speech, ataxia, tremors at higher acute exposures, and in isolated instances, unconsciousness, amnesia, and epileptic seizures. . . . Acute poisoning and mortality in humans have occurred after very high exposure to xylenes. Loss of consciousness occurs at approximately 10,000 ppm. Individuals recovering from severe overexposure exhibit EEG alterations, confusion, coma, nystagmus, gastrointestinal effects, and impaired renal and hepatic function. 6. Central nervous system depressant that produces lightheadedness, nausea, headache, and ataxia at low doses and confusion, respiratory depression, and coma at high doses. Above 200 ppm, xylene causes conjunctivitis, nasal irritation, and sore throats; it is a potent respiratory irritant at high concentrations. Xylene produces a defatting dermatitis with prolonged cutaneous exposure. 7. Repeated, prolonged exposure to fumes may produce conjunctivitis of the eye and dryness of the nose, throat, and skin. Direct liquid contact may result in flaky or moderate dermatitis. Inhalation of vapors may cause CNS excitation then depression, characterized by paresthesia, tremors, apprehension, impaired memory, weakness, nervous irritation, vertigo, headache, anorexia, nausea, and flatulence, and may lead to anemia and mucosal hemorrhage. Clinically, no bone marrow aplasia, but hyperplasia, moderate liver enlargement, necrosis, and nephrosis may occur.
Overall Reference: HSDB® Hazardous Substances Data Bank XYLENES 1330207 Section 0 Administrative Information Hazardous Substances Databank Number: 4500 Last Revision Date 20090626 Review Date Reviewed by SRP on 1/21/2009 1. Environmental Health Criteria 190 : Xylenes pp. 12 (1997) by the International Programme on Chemical Safety (IPCS) under the joint sponsorship of the United Nations Environment Programme, the International Labour Organisation and the World Health Organization. 2. Armour, M.A. Hazardous Laboratory Chemicals Disposal Guide. Boca Raton, FL: CRC Press Inc., 1991., p. 461 3. Mackison, F. W., R. S. Stricoff, and L. J. Partridge, Jr. (eds.). NIOSH/ OSHA Occupational Health Guidelines for Chemical Hazards. DHHS(NIOSH)				

Agent	Source	Type of job	Number of Workers	Human health effects*
Publication No. 81123 (3 VOLS). Washington, DC: U.S. Government Printing Office, Jan. 1981., p. 1 4. DHHS ATSDR; Toxicological Profile for Xylenes (Update) (PB2008100008) p.68 (August 2007) Available from, as of August 29, 2008: http://www.atsdr.cdc.gov/toxprofiles/tp71.pdf 5. American Chemistry Council Benzene, Toluene, and Xylenes VCCEP Consortium; Xylenes Category: mXylene (CAS No. 108383), oXylene (CAS No. 95476), pXylene (CAS No. 106423), Mixed Xylenes (CAS No. 1330207) Voluntary Children's Chemical Evaluation Program (VCCEP) Tier 1 Pilot Submission p 35. Docket Number OPPTS 00274D October 6, 2005. Available from, as of October 15, 2008: http://www.epa.gov/oppt/vccep/pubs/chem12a.htm 6. Ellenhorn, M.J. and D.G. Barceloux. Medical Toxicology Diagnosis and Treatment of Human Poisoning. New York, NY: Elsevier Science Publishing Co., Inc. 1988., p. 962 7. Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 19811982., p.3295				
Ethyl benzene	Oil	Rig workers, ship crews in hot zone	Moderate	1. Toxic to the central nervous system and is an irritant of mucous membranes and the eyes. Induces liver microsomal enzymes. 2. Prolonged exposure to vapors may result in functional disorders, increase in deep reflexes, irritation of upper respiratory tract, hematological disorders (leucopenia and lymphocytosis, in particular) and hepatobiliary complaints. 3. Aspiration of even a small amt may cause severe injury, since its low viscosity and surface tension will cause it to spread over a large surface of pulmonary tissue. 4. Produces an irritant effect from chronic inhalation at 100 ppm (0.492 mg/L)/8 hr. . . . Concn of 1 mg/L & even 0.1 mg/L may be dangerous & may produce functional & organic disturbances (nervous system disorders, toxic hepatitis & upper resp tract complaints). Concn as low as 0.01 mg/L may lead to inflammation of upper resp tract mucosa. Vapor has a transient irritant effect on human eyes at 200 ppm in air. At 1000 ppm on the first exposure it is very irritating and causes tearing, but tolerance rapidly develops. At 2000 ppm eye irritation and lacrimation are immediate and severe; 5000 ppm causes intolerable irritation of the eyes and nose.
Overall Reference: HSDB® Hazardous Substances Data Bank ETHYLBENZENE 100414 Section 0 Administrative Information Hazardous Substances Databank Number: 84 Last Revision Date 20050707 Review Date Reviewed by SRP on 1/29/2000 1. Environmental Health Criteria 186 : Ethylbenzene pp. 1920 (1996) by the International Programme on Chemical Safety (IPCS) under the joint sponsorship of the United Nations Environment Programme, the International Labour Organisation and the World Health Organization. 2. ILO - International Labour Office. Encyclopedia of Occupational Health and Safety. Vols. I&II. Geneva, Switzerland: International Labour Office, 1983., p. 2114				

Agent	Source	Type of job	Number of Workers	Human health effects*
3. Browning, E. Toxicity and Metabolism of Industrial Solvents. New York: American Elsevier, 1965., p. 92 4. Clayton, G.D., F.E. Clayton (eds.) Patty's Industrial Hygiene and Toxicology. Volumes 2A, 2B, 2C, 2D, 2E, 2F: Toxicology. 4th ed. New York, NY: John Wiley & Sons Inc., 1993-1994., p. 1344 5. Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 413				
PAHs[1] (Polycyclic Aromatic Hydrocarbons)				1. Certain unsubstituted PAHs are genotoxins. Cancer occurs predominantly in the lung and skin following inhalation and dermal exposure, respectively. 2. Dermal Effects. Mixtures of carcinogenic PAHs cause skin disorders, regressive verrucae (moles) and exacerbated skin lesions in patients with pre-existing skin conditions (pemphigus vulgaris and xeroderma pigmentosum). Workers exposed to substances that contain PAHs (e.g., coal tar) experienced chronic dermatitis and hyperkeratosis. 3. Lung and urinary tract cancer. 4. Other cancers: kidney, lung, nasal cavity, sinuses, skin, liver, pancreatic, kidney, and CNS, as well as a slight increase in other GI cancers. Several authors have noted an increase in brain tumors. 5. Can be absorbed through skin. Reproductive problems based on lab animal studies. Skin contact may cause redness, blistering and peeling. Respiratory irritation may be related to particulate PAHs.
Overall Reference: HSDB® Hazardous Substances Data Bank POLYCYCLIC AROMATIC HYDROCARBONS 130498292 Section 0 Administrative Information Hazardous Substances Databank Number: 7092 Last Revision Date 20040305 Review Date Reviewed by SRP on 10/2/2003 1. DHHS/ATSDR; Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs) pp.59, 121,163-4 (1995) 2. DHHS/NTP. 10th Report on Carcinogens. Available from, as of May 21, 2003: http://ehp.niehs.nih.gov/roc/toc10.html 3. Ellenhorn, M.J., S. Schonwald, G. Ordog, J. Wasserberger. Ellenhorn's Medical Toxicology: Diagnosis and Treatment of Human Poisoning. 2nd ed. Baltimore, MD: Williams and Wilkins, 1997., p. 1442 4. Rom, W.N. (ed.). Environmental and Occupational Medicine. 2nd ed. Boston, MA: Little, Brown and Company, 1992., p. 876-877 5. Wisconsin Department of Health and Family Services, Division of Public Health, with funds from the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services (POH 4606 Revised 12/2000)				
Benzo(a)-pyrene, BAP	Oil, burning oil	All	Large	Tumorigen, Mutagen, Human Data, Primary irritant, Reproductive effector. RTECS 1. B2; probable human carcinogen.

[1] Polycyclic aromatic hydrocarbons (PAHs) are organic substances made up of carbon and hydrogen atoms grouped into at least two condensed aromatic ring structures. These are divided into two categories: low molecular weight compounds composed of fewer than four rings and high molecular weight compounds of four or more rings. "PAH derivatives" include PAHs having an alkyl or other radical attached to a ring.

Agent	Source	Type of job	Number of Workers	Human health effects*
				2. A2; Suspected human carcinogen. 3. Benzopyrene is carcinogenic to humans (Group 1). 4. Benzo(a)pyrene: reasonably anticipated to be a human carcinogen. /Polycyclic Aromatic Hydrocarbons. 5. Neurobehavioral development in Tongliang children benefited by elimination of PAH exposure from the coal-burning plant
RTECS® Registry of Toxic Effects of Chemical Substances. Name Of Substance: Benzo(a)pyrene CAS Registry Number: 50328 General Information RTECS Number: DJ3675000 Review Date 201007 Overall Reference: HSDB® - Hazardous Substances Data Bank Benzo(a)pyrene 50-32-8 Section 0 - Administrative Information Hazardous Substances Databank Number: 2554 Last Revision Date 20100603 Review Date Reviewed by SRP on 1/21/2010 1. USEPA/IRIS; U.S. Environmental Protection Agency's Integrated Risk Information System (IRIS) on Benzo(a)pyrene (BaP) (50-32-8) Available from, as of March 15, 2000. http://www.epa.gov/ngispgm3/iris on the Substance File List. 2. ACGIH - American Conference of Governmental Industrial Hygienists. Threshold Limit Values of Chemical Substances and Biological Exposure Indices, ACGIH, Cincinnati, OH 2009, p. 13 3. IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Some Non-heterocyclic Polycyclic Aromatic Hydrocarbons and Some Related Industrial Exposures, v 92 (2005). Summary available from, as of November 29, 2009: http://monographs.iarc.fr/ENG/Meetings/index1.php] 4. DHHS/NTP - National Toxicology Program; Eleventh Report on Carcinogens: Benzo(a)pyrene (50-32-8) (January 2005). Available from, as of July 31, 2009: http://ntp.niehs.nih.gov/ntp/roc/eleventh/profiles/s150pah.pdf 5. Perera F et al; Environmental Health Perspectives 116 (10): 1396-1400 (2008). Available from, as of November 23, 2009				
Benz(a) anthracene	Oil, burning oil	All	Large	Tumorigen, Mutagen, Human Data. RTECS 1. B2; probable human carcinogen. 2. A2; Suspected human carcinogen. 3. Benzopyrene is probably carcinogenic to humans (Group 2A). 4. Benzo(a)pyrene: reasonably anticipated to be a human carcinogen. /Polycyclic Aromatic Hydrocarbons. 5. A mutagen as determined by the Ames test for mutagenicity.
RTECS® Registry of Toxic Effects of Chemical Substances. Name Of Substance: Benz(a)antracene CAS Registry Number: 56553 General Information RTECS Number: CV9275000 Review Date 200908. Overall Reference: HSDB® - Hazardous Substances Data Bank Benzo(a)pyrene 50-32-8 Section 0 - Administrative Information Hazardous Substances Databank Number: 2554 Last Revision Date 20100603 Review Date Reviewed by SRP on 1/21/2010 1. USEPA/IRIS; U.S. Environmental Protection Agency's Integrated Risk Information System (IRIS) on Benzo(a)pyrene (BaP) (50-32-8) Available from, as of March 15, 2000. http://www.epa.gov/ngispgm3/iris on the Substance File List.				

Agent	Source	Type of job	Number of Workers	Human health effects*
2. ACGIH - American Conference of Governmental Industrial Hygienists. Threshold Limit Values of Chemical Substances and Biological Exposure Indices, ACGIH, Cincinnati, OH 2009, p. 13 3. IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Some Non-heterocyclic Polycyclic Aromatic Hydrocarbons and Some Related Industrial Exposures, v 92 (2005). Summary available from, as of November 29, 2009: http://monographs.iarc.fr/ENG/Meetings/index1.php] 4. DHHS/NTP - National Toxicology Program; Eleventh Report on Carcinogens: Benz(a)anthracene (56-55-3) (January 2005). Available from, as of July 31, 2009: http://ntp.niehs.nih.gov/ntp/roc/eleventh/profiles/s150pah.pdf 5. Helmes CT et al; J Environ Sci Health Part A Environ Sci Eng 17 (3): 321-90 (1982).				
Benzo(b) fluoranthene	Oil, burning oil	All	Large	Tumorigen, Mutagen, Human Data. RTECS 1. B2; probable human carcinogen. 2. A2; Suspected human carcinogen. 3. Benzo(b)fluoranthene is possibly carcinogenic to humans (Group 2B). 4. Benzo(b)fluoranthene: reasonably anticipated to be a human carcinogen. /Polycyclic Aromatic Hydrocarbons. 5. . . . carcinogenic polycyclic aromatic hydrocarbons (PAHs) produce severe, long-term immunotoxicity.
RTECS® Registry of Toxic Effects of Chemical Substances. Name Of Substance: Benz(e)acephenanthrylene CAS Registry Number: 205-99-2 General Information RTECS Number: CU1400000 Review Date 200908. Overall Reference: HSDB® - Hazardous Substances Data Bank Benzo(b)fluoranthene 205-99-2 Section 0 - Administrative Information Hazardous Substances Databank Number: 4035 Last Revision Date 20050623 Review Date Reviewed by SRP on 5/7/1998 1. USEPA/IRIS; U.S. Environmental Protection Agency's Integrated Risk Information System (IRIS) on Benzo(b)fluoranthene (205-99-2) Available from, as of March 15, 2000. http://www.epa.gov/ngispgm3/iris on the Substance File List. 2. ACGIH - American Conference of Governmental Industrial Hygienists. Threshold Limit Values of Chemical Substances and Biological Exposure Indices, ACGIH, Cincinnati, OH 2008, p. 13 3. IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p.58 (1987) 4. DHHS/NTP - National Toxicology Program; Eleventh Report on Carcinogens: Polycyclic Aromatic Hydrocarbons, Benzo(b)fluoranthene (205-99-2) (January 2005). Available from, as of July 31, 2009: http://ntp.niehs.nih.gov/ntp/roc/eleventh/profiles/s150pah.pdf 5. Doull, J., C.D.Klassen, and M.D. Amdur (eds.). Casarett and Doull's Toxicology. 3rd ed., New York: Macmillan Co., Inc., 1986., p. 272				
Naphthalene	Oil, burning oil	All	Large	Tumorigen, Mutagen, Reproductive Effector, Human Data, Primary Irritant. RTECS 1. Overall, no data are available to evaluate the carcinogenic potential in exposed human populations. Group C, a possible human carcinogen. 2. A4; Not classifiable as a human carcinogen.

Agent	Source	Type of job	Number of Workers	Human health effects*
				3. Naphthalene is possibly carcinogenic to humans (Group 2B). 4. Naphthalene: reasonably anticipated to be a human carcinogen. 5. . . . carcinogenic polycyclic aromatic hydrocarbons (PAHs) produce severe, long-term immunotoxicity. 6. Poisoning may occur by ingestion of large doses, inhalation, or skin absorption. 7. Skin rashes and systemic poisoning in infants. 8. Severe poisoning in humans resulted in hemoglobinuria, methemoglobinemia, the production of Heinz bodies, ... death, and/or kernicterus. 9. Anemia, jaundice, headache, confusion, nausea, and vomiting. 10. A. Surface contact: 1. Naphthalene cataracts and ocular irritation. 2. skin irritation and, in the case of a sensitized person, severe dermatitis. 3. Percutaneous absorption ... inadequate to produce acute systemic reactions except in newborns. B. Inhalation of vapor: 1. Headache, confusion, and excitement. 2. Nausea and sometimes vomiting, and extensive sweating. 3. Dysuria, hematuria, & the acute hemolytic reaction described below. 4. Rarely optic neuritis is encountered. C. Ingestion: 1. Abdominal cramps with nausea, vomiting, and diarrhea. 2. Headache, profuse perspiration, listlessness, confusion. 3. In severe poisoning, coma with or without convulsions. 4. Irritation of the urinary bladder ... Signs & symptoms: urgency, dysuria, & the passage of a brown or black urine with or without albumin & casts. ... 5. Acute intravascular hemolysis is the most characteristic sign. ... It begins on the 3rd day & is accompanied by anemia, leukocytosis, fever, hemoglobinuria, jaundice, renal insufficiency, and sometimes, disturbances in liver function. 6. In the absence of adequate supportive treatment, death may result from acute renal failure in adults or kernicterus in young infants. 11. Confusion, altered sensorium, listlessness and lethargy, and vertigo. Muscle twitching, convulsions, decreased responses to painful stimuli, and coma upon ingestion.

RTECS® Registry of Toxic Effects of Chemical Substances. Name Of Substance: Naphthalene CAS Registry Number: 91-20-3 General Information RTECS Number: QJ0525000 Review Date 201004.

Overall Reference: HSDB® - Hazardous Substances Data Bank Naphthalene 91-20-3 Section 0 - Administrative Information Hazardous Substances Databank Number: 184 Last Revision Date 20050624 Review Date Reviewed by SRP on 10/2/2003

1. USEPA/IRIS; U.S. Environmental Protection Agency's Integrated Risk Information System (IRIS) for Naphthalene (91-20-3) Available from: http://www.epa.gov/ngispgm3/iris on the Substance File List as of March 15, 2000
2. ACGIH - American Conference of Governmental Industrial Hygienists. Threshold Limit Values of Chemical Substances and Biological Exposure Indices, ACGIH, Cincinnati, OH 2008, p. 42

Agent	Source	Type of job	Number of Workers	Human health effects*
3. IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p.418 (2002) 4. DHHS/NTP - National Toxicology Program; Eleventh Report on Carcinogens: Naphthalene (91-20-3) (January 2005). Available from, as of July 31, 2009: http://ntp.niehs.nih.gov/ntp/roc/eleventh/profiles/s116znph.pdf 5. Doull, J., C.D.Klassen, and M.D. Amdur (eds.). Casarett and Doull's Toxicology. 3rd ed., New York: Macmillan Co., Inc., 1986., p. 272 6. Budavari, S. (ed.). The Merck Index - Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ: Merck and Co., Inc., 1989., p. 1008 7. USEPA/ODW; Drinking Water Health Advisories for 15 Volatile Organic Chemicals p. I-7 (1990) NTIS No. PB90-259821 8. American Conference of Governmental Industrial Hygienists. Documentation of Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices for 2001. Cincinnati, OH. 2001., p. 3 9. USEPA; Toxicological Review of Naphthalene p. 7 (August 1998). Available from, as of July 21, 2003: http://www.epa.gov/iris/toxreviews/0436-tr.pdf 10. Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984., p. III-309 11. DHHS/ATSDR; Toxicological Profile for Naphthalene, 1-Methylnapthalene, 2-Methylnapthalene p.43 (1995). Available from, as of July 17, 2003: http://www.atsdr.cdc.gov/toxprofiles/tp67.html				
Dispersants:				
2-butoxy-ethanol	Dispersant	Rig workers, ship crews in hot zone, VoO crews	Moderate	1. Moderate acute toxicity; irritating to the eyes and skin. 2. Central nervous depression, although probably less prominent than with ethylene glycol. Nausea, vomiting, and sometimes diarrhea. Prominent headache. Later abdominal and lumbar pain and costovertebral angle tenderness. Transient polyuria and then oliguria, progressing to anuria. Acute renal failure. Less critical pathological lesions may appear in brain, lung, liver, meninges and heart. 3. First sign of organic abnormality resulting from excessive exposure by any route likely would be abnormal blood picture characterized by erythropenia, reticulocytosis, granulocytosis, and leucocytosis. Somewhat more intense exposure would be likely to cause fragility of erythrocytes and hematuria.. 4. The effects of alkyl derivatives of ethylene glycol upon the CNS include headache, drowsiness, weakness, slurred speech, recrudescent stuttering, staggering gait, tremor, and blurred vision. Changes of personality are often noted. These changes are such that the patient, in the absence of an accurate occupational history, may be treated for schizophrenia or narcolepsy. In acute poisoning with the ethylene glycol monoalkyl ethers, there is ...renal injury: albuminuria and hematuria. 5. A number of species, including humans, are relatively insensitive to the hemolytic effects of ethylene glycol mono-n-butyl ether.

Agent	Source	Type of job	Number of Workers	Human health effects*
Overall Reference: HSDB® Hazardous Substances Data Bank ETHYLENE GLYCOL MONONBUTYL ETHER 111762 Section 0 Administrative Information Hazardous Substances Databank Number: 538 Last Revision Date 20100302 Review Date Reviewed by SRP on 5/13/2004 1. World Health Organization/ International Programme on Chemical Safety. Concise International Chemical Assessment Document No. 10. 2-Butoxyethanol p.4 (1998) 2. Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984., p. II176 3. Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 19811982., p.3933 4. Hamilton, A., and H. L. Hardy. Industrial Toxicology. 3rd ed. Acton, Mass.: Publishing Sciences Group, Inc., 1974., p. 301 5. Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 19 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V7 139				
Propylene glycol	Dispersant	Rig workers, ship crews in hot zone, VoO crews	Moderate	1. Mildly irritating to the eyes. 2. May cause primary skin irritation in some people, possibly due to dehydration, but the material is not a sensitizer. 3. May cause transitory stinging, blepharospasm, and lacrimation. 4. Ocular exposure causes mild ocular irritation with hyperemia; chronic or prolonged skin and mucous membranes exposure may also cause irritation; gastrointestinal disturbances, nausea and vomiting have been observed after ingestion. . . . Symptomatology is dose-dependent, ranging from drowsiness to stupor, deep unconsciousness, and coma. Other signs include hyperosmolality of serum, lactic acidosis, and hypoglycemia. . . . Chronic exposure may cause lactic acidosis, hypoglycemia, stupor, and seizures. 5. Oral or IV administration may exacerbate dermatitis in some individuals. 6. Although noninjurious, a drop applied to the human eye causes immediate stinging, blepharospasm and lacrimation. Discomfort lasts for several sec until tears wash the foreign substance away. This is followed by mild transient conjunctival hyperemia, but no residual discomfort or injury.
Overall Reference: HSDB® Hazardous Substances Data Bank Propylene glycol 57556 Section 0 Administrative Information Hazardous Substances Databank Number: 174 Last Revision Date 20101015 Review Date Reviewed by SRP on 5/13/2010 1. OECD - Organization for Economic Cooperation and Development; Screening Information Data Set for 1,2Dihydroxypropane (57556) p. (2001). Available from, as of December 31, 2009: http://www.chem.unep.ch/irptc/sids/OECDSIDS/sidspub.html 2. Cavender FL, Sowinski EJ; Patty's Toxicology CDROM (2005). NY, NY: John Wiley & Sons; Glycols. Online Posting Date: April 16, 2001 3. Bingham, E.; Cohrssen, B.; Powell, C.H.; Patty's Toxicology Volumes 19 5th ed. John Wiley & Sons. New York, N.Y. (2001)., p. V7 33 4. IPCS; Poisons Information Monograph 443: Propylene glycol (May 1994). Available from, as of January 4, 2009:				

Agent	Source	Type of job	Number of Workers	Human health effects*	
http://www.inchem.org/documents/pims/chemical/pim443.htm 5. DHHS/NTPCERHR; NTPCERHR Monograph on the Potential Human Reproductive and Developmental Effects of Propylene Glycol (March 2004) NIH Pub No. 04-4482 p.II-44. Available from, as of January 11, 2010: http://cerhr.niehs.nih.gov/reports/index.html 6. Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 769					
Other surfactants	Dispersant	Rig workers, ship crews in hot zone, VoO crews	Moderate	N/A	
Cleaning/Decontamination:					
Limonene	Cleaning chemical	Cleaners, Decon workers	Moderate	1. Skin irritant. 2. Liquid irritates eyes; ingestion causes irritation of GI tract. 3. The monoterpenes (such as limonene) are major components of the resin from many common softwoods and are associated with mouth and throat irritation, shortness of breath, and impaired lung function. 4. No toxic reactions have been described other than mild local irritation and skin sensitization, but albuminuria and hematuria are probable if ingested in sufficient quantity.	
Overall Reference: HSDB® Hazardous Substances Data Bank LIMONENE 138863 Section 0 Administrative Information Hazardous Substances Databank Number: 1809 Last Revision Date 20060830 Review Date Reviewed by SRP on 5/11/2006 1. O'Neil, M.J. (ed.). The Merck Index An Encyclopedia of Chemicals, Drugs, andBiologicals. 13th Edition, Whitehouse Station, NJ: Merck and Co., Inc., 2001., p. 984 2. CHRIS - U.S. Coast Guard, Department of Transportation. CHRIS Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 19845. 3. ILO - International Labour Office. Encyclopaedia of Occupational Health and Safety. 4th edition, Volumes 14 1998. Geneva, Switzerland: International Labour Office, 1998., p.71.9 4. Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984., p. II-259					
Fuel Related, Diesel/Gas:					
Elemental carbon	Diesel	Fuel distributors, ship crew	Moderate	1. Dust irritation, particularly to the eyes and mucous membranes. 2. Inhalation of carbon dust can immediately give rise to an increased mucociliary transport & airway resistance immediately by the vagus.	
Overall Reference: HSDB ® Hazardous Substances Data Bank CARBON 7440440 Section 0 Administrative Information Hazardous Substances Databank Number: 5037 Last Revision Date 20090420 Review Date Reviewed by SRP on 9/18/2008 1. Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p.					

Agent	Source	Type of job	Number of Workers	Human health effects*
704 2. Friberg, L., G.R. Nordberg, and V.B. Vouk. Handbook on the Toxicology of Metals. New York: Elsevier North Holland, 1979., p. 72				
Carbon monoxide	Gasoline, diesel	VoOs, engine room workers	Moderate	1. The most common symptoms of CO poisoning are headache, dizziness, weakness, nausea, vomiting, chest pain, and altered mental status. Symptoms of severe CO poisoning include malaise, shortness of breath, headache, nausea, chest pain, irritability, ataxia, altered mental status, other neurologic symptoms, loss of consciousness, coma, and death; signs include tachycardia, tachypnea, hypotension, various neurologic findings including impaired memory, cognitive and sensory disturbances; metabolic acidosis, arrhythmias, myocardial ischemia or infarction, and noncardiogenic pulmonary edema, although any organ system might be involved. 2. The symptoms and signs of acute carbon monoxide poisoning correlate poorly with the level of carboxyhemoglobin measured at the time of arrival at the hospital. Carboxyhemoglobin levels below 10% are usually not associated with symptoms. At higher carboxyhemoglobin saturations of 1030%, neurological symptoms of carbon monoxide poisoning can occur, such as headache, dizziness, weakness, nausea, confusion, disorientation and visual disturbances. Exertional dyspnea, increases in pulse and respiratory rates and syncope are observed with continuous exposure, producing carboxyhemoglobin levels from 30% to 50%. When carboxyhemoglobin levels are higher than 50%, coma, convulsions and cardiopulmonary arrest may occur. Complications occur frequently in carbon monoxide poisoning (immediate death, myocardial impairment, hypotension, arrhythmias, pulmonary edema). Perhaps the most insidious effect of carbon monoxide poisoning is the delayed development of neuropsychiatric impairment within 1-3 weeks and the neurobehavioral consequences, especially in children. 3. In increasing order of severity/: No symptoms or shortness of breath during vigorous muscular exercise (0 to 10% carboxyhemoglobin (COHb). A mild headache ...and breathlessness on moderate exercise (10-20% COHb). Throbbing headache, irritability, emotional instability, impaired judgement, defective memory, and rapid fatigue (20-30% COHb). Severe headache, weakness, nausea and vomiting, dizziness, dimness of vision, confusion (30-40% COHb). Increasing confusion, sometimes hallucinations, severe ataxia, accelerated respirations...(40-50% COHb). Syncope or coma with intermittent convulsions, tachycardia with a weak pulse...(50-60% COHb)... Pallor or cyanosis. Increasing depth of coma with incontinence of urine & feces (60-70% COHb). Profound coma with depressed or absent reflexes, a weak thread pulse, shallow and irregular

Agent	Source	Type of job	Number of Workers	Human health effects*
				respirations and complete quiescence (70-80% COHb). Rapid death from respiratory arrest (above 80% COHb). Miscellaneous and atypical reactions include various skin lesions, sweating, hepatomegaly, hyperpyrexia, albuminuria, oliguria, anginal pain, and congestive heart failure ... During convalescence a bronchopneumonia may develop because of the aspiration of saliva or vomitus ... Myocardial infarction, with or without coronary thrombosis, may appear at any time up to one week following an acute poisoning. After an uneventful convalescence, signs of nerve or brain injury may appear at any time within three weeks following an acute exposure. Among permanent sequelae are neuropathies, various motor and mental defects, some of which mimic multiple sclerosis or parkinsonism, and death. 4. TOXIC - FLAMMABLE/ Health: TOXIC; may be fatal if inhaled or absorbed through skin. Contact with gas or liquefied gas may cause burns, severe injury and/or frostbite.
Overall Reference: HSDB® Hazardous Substances Data Bank Carbon monoxide 630080 Section 0 Administrative Information Hazardous Substances Databank Number: 903 Last Revision Date 20100430 Review Date Reviewed by SRP on 1/21/2010 1. CDC; Clinical Guidance for Carbon Monoxide (CO) Poisoning After a Disaster (September 2008). Available from, as of November 11, 2009: http://www.bt.cdc.gov/disasters/coguidance.asp 2. IPCS - Environmental Health Criteria 213 : Carbon Monoxide pp. 1-12 (1999) by the International Programme on Chemical Safety (IPCS) under the joint sponsorship of the United Nations Environment Programme, the International Labour Organisation and the World Health Organization. 3. Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984., p. III-98 4. U.S. DOT - Department of Transportation. 2008 Emergency Response Guidebook. Washington, D.C. 2008				
Gasoline exhaust	Gasoline	VoOs, fuel distributors	Small-moderate	1. Vapor irritating to eyes, nose, and throat. 2. Signs and symptoms include incoordination, restlessness, excitement, confusion, disorientation, ataxia, delirium, and finally coma, which may last a few hours or several days. . . . Intoxication by ingestion of gasoline and kerosene resembles that from ethyl alcohol. Signs and symptoms include incoordination, restlessness, excitement, confusion, disorientation, ataxia, delirium, and finally coma, which may last a few hours or several days. . . . Inhalation of high concentrations of gasoline vapors, as by workmen cleaning storage tanks, can cause immediate death. Gasoline vapors sensitize the myocardium such that small amounts of circulating epinephrine may precipitate ventricular fibrillation. High concentrations of gasoline vapor may also lead to rapid depression of the CNS and death from respiratory failure. 3. Can include dizziness, headaches, giddiness, euphoria, vertigo, blurred vision, nausea, numbness, drowsiness, anesthesia, and coma. Chronic exposure is associated with

Agent	Source	Type of job	Number of Workers	Human health effects*
				neurological effects as well. 4. Acts generally as an anesthetic and mucous membrane irritant. The hazard is high because of the ease in which harmful concentration may develop. Inhalation is the most important route of occupational entry... Reported responses to gasoline vapors are: 160-270 ppm causes eye and throat irritation in several hours; 500-900 ppm causes eye, nose and throat irritation, and dizziness in 1 hour; and 2000 ppm produces mild anesthesia in 30 minutes. Higher concentrations are intoxicating in 4-10 minutes. The threshold for immediate mild toxic effect is 900-1000 ppm. . . . A3; Confirmed animal carcinogen with unknown relevance to humans . 5. In human beings, inhaling gasoline vapor may cause inebriation and may lead to unconsciousness. During inebriation, miosis has been noted, and in comatose individuals, mydriasis and nystagmus. 6. Gasoline vapor acts as a central nervous system depressant. Exposure to low concentrations may produce flushing of the face, staggering gait, slurred speech, and mental confusion. In high concentrations, gasoline vapor may cause unconsciousness, coma, and possible death resulting from respiratory failure. 7. IARC Group 2B: The agent is possibly carcinogenic to humans. 8. Mutagen. Source: RTECS

Overall Reference : HSDB® Hazardous Substances Data Bank GASOLINE 8006619 Section 0 Administrative Information Hazardous Substances Databank Number: 6477 Last Revision Date 20050623 Review Date Reviewed by SRP on 1/15/2004

1. CHRIS - U.S. Coast Guard, Department of Transportation. CHRIS Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 19845.
2. Hardman, J.G., L.E. Limbird, P.B., A.G. Gilman. Goodman and Gilman's The Pharmacological Basis of Therapeutics. 10th ed. New York, NY: McGrawHill, 2001., p.1884
3. DHHS/ATSDR; Toxicological Profile for Automotive Gasoline p.32 (1995)
4. ACGIH - American Conference of Governmental Industrial Hygienists. Documentation of Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices for 2001. Cincinnati, OH. 2001., p. 3
5. Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 714
6. Sittig, M. Handbook of Toxic And Hazardous Chemicals. Park Ridge, NJ: Noyes Data Corporation, 1981., p. 348
7. IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V45 194 (1989)
8. RTECS. Registry of Toxic Effects of Chemical Substances® Name Of Substance: Gasoline exhaust particles, crude extract General Information RTECS Number: LX3360000 Review Date 199410

Agent	Source	Type of job	Number of Workers	Human health effects*
Sunscreens:				
Sunscreen	Sunscreen	Beach crew	Large	Schering-Plough – (Only 2 ingredients with occupational exposure limits, below.) May cause slight skin irritation under occlusive conditions. Eye contact may cause slight eye irritation with temporary stinging, redness, tearing, and increased blinking.
1. Schering-Plough MSDS SP000039 Coppertone Emulsion Lotions				
Triethanol-amine	Sunscreen	Beach crew	Large	1. Liquid may irritate eyes and skin. 2. Mild skin irritation only in concentrations above 5%; little skin sensitization develops. 3. Three cases of occupational asthma caused by ethanolamines were summarized. ...The three cases share one common feature: exposure to triethanolamines occurred at temperatures higher than that of the ambient air.
Overall Reference: HSDB ® Hazardous Substances Data Bank TRIETHANOLAMINE 102716 Section 0 Administrative Information Hazardous Substances Databank Number: 893 Last Revision Date 20090203 Review Date Reviewed by SRP on 1/15/2004 1. Prager, J.C. Environmental Contaminant Reference Databook Volume 2. New York, NY: Van Nostrand Reinhold, 1996., p. 376 2. Ellenhorn, M.J. and D.G. Barceloux. Medical Toxicology Diagnosis and Treatment of Human Poisoning. New York, NY: Elsevier Science Publishing Co., Inc. 1988., p. 907 3. Savonius B et al; Allergy 49 (10): 877-881 (1994)				
Barium Sulfate	Sunscreen	Beach crew	Large	1. <10% Inhaled fine dusts of barium sulfate form harmless nodular granules in lung, an affliction called baritosis. Baritosis produces no symptoms of bronchitis or emphysema, and lung function is not affected, although some patients complain of dyspnea upon exertion; the nodulation disappears if exposure is stopped.
Overall Reference: HSDB ® Hazardous Substances Data Bank BARIUM SULFATE 7727437 Section 0 Administrative Information Hazardous Substances Databank Number: 5041 Last Revision Date 20050623 Review Date Reviewed by SRP on 5/6/2000 1. Venugopal, B. and T.D. Luckey. Metal Toxicity in Mammals, 2. New York: Plenum Press, 1978., p. 67				
Sunscreen	Sunscreen	Beach crew	Large	1. Rocky Mountain Sunscreen – (No ingredients listed.) Prolonged contact can cause irritation, redness and blurred vision.
1. Rocky Mountain Sunscreen Company MSDS Suntan Lotion MSDS NO. 135-009 & 010				
Metals (typically associated with oil):				
Aluminum			Large	1. Non-occupational human exposure to aluminum in the environment is primarily through ingestion of food and water. No acute pathogenic effects in the general population have been described after exposure to aluminum. Although it has been hypothesized that aluminum is a risk factor for Alzheimer's disease, present epidemiological evidence does not support a causal association between Alzheimer's disease and aluminum in drinking-

Agent	Source	Type of job	Number of Workers	Human health effects*
				water. Neurological syndromes including impairment of cognitive function, motor dysfunction and peripheral neuropathy have been reported in limited studies of workers exposed to aluminum fume. Although human exposure to aluminum is widespread, in only a few cases has hypersensitivity been reported following exposure to some aluminum compounds after dermal application or parenteral administration. There is insufficient information to allow for classification of the cancer risk from human exposures to aluminum and its compounds. Aluminum and its compounds appear to be poorly absorbed in humans. The mechanism of gastrointestinal absorption of aluminum has not yet been fully elucidated. The highest levels of aluminum may be found in the lungs, where it may be present as inhaled insoluble particles. 2. On occasion workers chronically exposed to aluminum-containing dusts or fumes have developed severe pulmonary reactions including fibrosis, emphysema and pneumothorax. A much rarer encephalopathy has also been described. 3. Aluminum fibrosis of lung with encephalopathy was reported. Presenting symptoms were referable to CNS, and death resulted from bronchopneumonia following progressive encephalopathy associated with epileptiform seizures, although radiographic exam of chest of 53 other factory workers and clinical exam of 23 of them revealed no definite cases of aluminum fibrosis. Aluminum content of brain and lung was about 20 times normal. 4. A reported high incidence of bladder cancer in a region of Quebec, Canada where aluminum production takes place resulted in the initiation of a case-control study. Workers in 5 aluminum reduction plants were assessed with respect to incidence of bladder cancer. The number of men working in the plants was 300-l,200 except for 1 plant with 7,800 workers. The number of bladder cancer cases was collected from regional hospitals over a 10-year period, and the number of current or former employees from the aluminum plants identified. For each case, 3 controls who had never had bladder cancer were selected. Detailed occupational histories of each man (case and controls) were collected from the companies and included each division, department, and job to which the men had been assigned; smoking history; and estimated assessment of tar and PAH exposure (based on benzene soluble material and benz(a)pyrene concentrations in workplace air) for each occupation. 5. …Recently reported adverse effects of aluminum in humans have resulted from inhalation or ingestion of aluminum in concentrations many times greater than the amounts present

Agent	Source	Type of job	Number of Workers	Human health effects*
				in normal circumstances. Following large oral doses of aluminum, toxic syndromes involve gastrointestinal tract irritation and eventually, interference with phosphate absorption, which results in rickets. Industrial exposure to high concentrations of aluminum-containing airborne dusts has resulted in a number of cases of occupational pneumoconiosis. Most of these exposures were chronic, and other substances were involved in nearly all instances. For example, an asthma-like disease has been reported in workers engaged in the production of aluminum from its oxide. This condition may result from the hydrogen fluoride that evolves from the use of fluorine-bearing materials in the production of metallic aluminum. Silicosis, aluminosis, aluminum lung, and bauxite pneumoconiosis are the result of pulmonary fibrotic reactions to silical and aluminum-containing compounds, which have been observed in the lung tissue in humans.
Overall Reference: HSDB® Hazardous Substances Data Bank ALUMINUM, ELEMENTAL 7429905 Section 0 Administrative Information Hazardous Substances Databank Number: 507 Last Revision Date 20050624 Review Date Reviewed by SRP on 9/16/2004 1. WHO - World Health Organization/ International Programme on Chemical Safety. Environmental Health Criteria 194 . Aluminium. pp. 1-13 (1997) 2. Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984., p. II-128 3. Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982., p.1498 4. DHHS/ATSDR; Toxicological Profile for Aluminum (July 1999). Available from, as of May 21, 2004: http://www.atsdr.cdc.gov/toxprofiles/tp22.html 5. National Research Council. Drinking Water & Health, Volume 4. Washington, DC: National Academy Press, 1981., p. 159				
Cadmium			Large	1. Cadmium and cadmium compounds are carcinogenic to humans (IARC Group 1). 2. IRIS B1; probable human carcinogen. 3. ACGIH A2; Suspected human carcinogen. 4. Hypertension. 5. Excessive inhalation of cadmium fumes and dusts results in loss of ventilatory capacity, with a corresponding increase in residual lung volume. Dyspnea is the most frequent complaint of patients with cadmium induced lung disease. 6. Acute poisoning may result from inhalation of cadmium dusts & fumes & from ingestion of cadmium salts. When swallowed, cadmium compounds are much less lethal than when inhaled, in part because they induce vomiting & are not retained. Although as little as 10-20 mg of sol cadmium salts have produced severe toxic symptoms when ingested, death probably requires several hundred milligrams by oral route. 7. Inhalation of cadmium dusts, salts & fume over a number of ... years result in chronic

Agent	Source	Type of job	Number of Workers	Human health effects*
				cadmium poisoning, a disease characterized by distinctive, nonhypertrophic emphysema with or without renal tubular injury, in which urinary excretion of a protein of molecular wt of 20,000 to 30,000 occurs. ... Further inhalation overexposure results in irreversible renal tubular damage, which may progress into complete Fanconi syndrome with decreased tubular reabsorption of proteins, glucose, amino acids, calcium, phosphorus, & with decreased ability to acidify & concentrate the urine. Other ... toxic effects include anemia, eosinophilia, anosmia, chronic rhinitis, yellow discoloration of teeth, & bone changes.
1. IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. 58 210 (1993) 2. IRIS - U.S. Environmental Protection Agency's Integrated Risk Information System (IRIS) on Cadmium (7440-43-9) from the National Library of Medicine's TOXNET System, March 6, 1995 3. ACGIH 2008 - American Conference of Governmental Industrial Hygienists TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH, 2008, p. 16 4. Engvall J, Perk J; Arch Env Health 40 (3): 185-90 (1985) 5. Hardman, J.G., L.E. Limbird, P.B. Molinoff, R.W. Ruddon, A.G. Goodman (eds.). Goodman and Gilman's The Pharmacological Basis of Therapeutics. 9th ed. New York, NY: McGraw-Hill, 1996., p. 1663 6. Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984., p. III-78 7. ACGIH 1986. American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values and Biological Exposure Indices. 5th ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists, 1986., p. 87				
Lead			Large	1. Inorganic lead compounds are probably carcinogenic to humans (IARC Group 2A). 2. NTP Reasonably anticipated to be a human carcinogen. 3. Disturbances in reaction time, visual motor performance, hand dexterity, IQ test and cognitive performance, nervousness, mood or coping ability were observed in lead workers with blood lead levels of 5080 ug/dL. 4. Toxic by ingestion and inhalation of dust or fume. 5. Inhalation, human TCLo: 10 ug/m3 Gastrointestinal: Gastritis; Liver: Other changes. 6. Peripheral nerve and sensation: Flaccid paralysis without anesthesia (usually neuromuscular blockage); Behavioural: Hallucinations, distorted perceptions; Behavioral: Muscle weakness. 7. Human systemic effects by ingestion and inhalation: loss of appetite, anemia, malaise, insomnia, headace, irritability, muscle and joint pains, tremors, flaccid paralysis without anesthesia, hallucinations and distorted perceptions, muscle weakness, gastritis, and liver changes. The major organ systems affected are the nervous system, blood system, and

Agent	Source	Type of job	Number of Workers	Human health effects*
				kidneys. Lead encephalopathy is accompanied by severe cerebral edema, increase in cerebral spinal fluid pressure, proliferation and swelling of endothelial cells in capillaries and arterioles, proliferation of glial cells, neuronal degeneration, and areas of focal cortical necrosis in fatal cases. Experimental evidence now suggests that blood levels of lead below 10 ug/dL can have the effect of diminishing the IQ scores of children. Low levels of lead impair neurotransmission and immune system function and may increase systolic blood pressure. Reversible kidney damage can occur from acute exposure. Chronic exposure can lead to irreversible vascular sclerosis, tubular cell atrophy, interstitial fibrosis, and glomerular sclerosis. Severe toxicity can cause sterility, abortion, and neonatal mortality and morbidity.
Overall Reference: HSDB® Hazardous Substances Data Bank Lead compounds Section 0 Administrative Information Hazardous Substances Databank Number: 6923 Last Revision Date 20100902 Review Date Reviewed by SRP on 1/21/2010 1. IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: http://monographs.iarc.fr/index.php, p. V87 11 (2006) 2. DHHS/NTP /National Toxicology Program; Eleventh Report on Carcinogens: Lead, and Lead Compounds (January 2005). Available from, as of July 31, 2009: http://ntp.niehs.nih.gov/ntp/roc/eleventh/profiles/s101lead.pdf 3. Arnvig E et al; Toxicol Lett 5: 399404 (1980) as cited in U.S. Dept Health & Human Services/Agency for Toxic Substances & Disease Registry; Toxicological Profile for Lead (Update) p.38 (1993) ATSDR/ TP92/12 4. Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987., p. 687 5. Vrachebnoe Delo. Medical Practice. (V/O Mezhdunarodnaya Kniga, 113095 Moscow, USSR) No.1- 1918- (5),107,1981 6. JAMA, Journal of the American Medical Association. (AMA, 535 N. Dearborn St., Chicago, IL 60610) V.1- 1883- 237,2627,1977 7. Lewis, R.J. Sr. (ed) Sax's Dangerous Properties of Industrial Materials. 11th Edition. Wiley Interscience, Wiley & Sons, Inc. Hoboken, NJ. 2004., p. 2209				
Nickel			Large	1. IRIS A; human carcinogen. 2. IARC Metallic nickel is possibly carcinogenic to humans (Group 2B). 3. ACGIH A5: Not suspected as a human carcinogen. 4. Nickel metal is well known cause of contact dermatitis in sensitized individuals. In stances of dermatitis in region of eyes has resulted from contact with nickel spectacle frames. 5. Excess risk of cancer of nasal cavity & lung. 6. Exposure to nickel containing vapors has been reported to be assoc with asthma. …Pneumoconiosis has been reported among workers exposed to nickel dust. 7. Toxic as dust or powder. 8. Delayed type hypersensitivity to nickel is one of the most common allergies.

Agent	Source	Type of job	Number of Workers	Human health effects*
				9. Asthma, urticaria, erythema multiforme, contact dermatitis, and hand eczema may follow use of objects made with nickel.
1. IRIS - U.S. Environmental Protection Agency's Integrated Risk Information System (IRIS) on Nickel refinery dust (NO CAS RN) from the National Library of Medicine's TOXNET System, March 1, 1995 2. IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V49 410 (1990) 3. ACGIH - American Conference of Governmental Industrial Hygienists TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH, 2008, p. 43 4. Grant, W.M. Toxicology of the Eye. 3rd ed. Springfield, IL: Charles C. Thomas Publisher, 1986., p. 661 5. IARC 1976. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work)., p. V11 104 (1976) 6. Friberg, L., Nordberg, G.F., Kessler, E. and Vouk, V.B. (eds). Handbook of the Toxicology of Metals. 2nd ed. Vols I, II.: Amsterdam: Elsevier Science Publishers B.V., 1986., p. V2 473 7. Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987., p. 818 8. Marks, J.G. Jr., DeLeo V.A., Contact and Occupational Dermatology. St. Louis, MO: Mosby Year Book 1992., p. 83 9. Ellenhorn, M.J., S. Schonwald, G. Ordog, J. Wasserberger. Ellenhorn's Medical Toxicology: Diagnosis and Treatment of Human Poisoning. 2nd ed. Baltimore, MD: Williams and Wilkins, 1997., p. 1604				
Vanadium			Large	1. Vanadium is a primary irritant to the skin. 2. In the consolidated form, vanadium metal and its alloys pose no particular health or safety hazard. The toxicity of vanadium alloys may depend upon other components in the alloy.
1. NIOSH; Criteria Document: Vanadium p.2 (1980) DHEW Pub. NIOSH 77-222 2. Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. 23(83) 684				
Hydrogen sulfide	Oil, plants in oil	Rig workers, confined space workers	Small	1. Irritant to eyes and mucuous membranes. . . . Low concentrations of 20-150 ppm cause irritation of the eyes; slightly higher concentrations may cause irritation of the upper respiratory tract, and if exposure is prolonged, pulmonary edema may result. The irritant action has been explained on the basis that hydrogen sulfide combines with the alkali present in moist surface tissues to form sodium sulfide, a caustic. 2. The irritant effect of H2S extends rather uniformly throughout the entire respiratory tract, resulting in rhinitis, pharyngitis, laryngitis, bronchitis, and pneumonia. Cough, sore throat, hoarseness, runny nose, and chest tightness are the most common symptoms of exposure between 50 and 250 ppm. 3. Low to moderately high vapor concentrations 1. Irritant actions. Eyes: Painful

Agent	Source	Type of job	Number of Workers	Human health effects*
				conjunctivitis, photophobia, lacrimation, & corneal opacity. Resp Tract: Rhinitis with anosmia, tracheobronchitis with pain and cough, pulmonary edema with dyspnea, sometimes late bronchopneumonia. Skin: Direct contact (as soln) may produce erythema & pain. B. Very high vapor concentrations: 1. Sudden collapse & unconsciousness, with or without a warning cry. 2.Death from prompt resp paralysis, usually terminal asphyxia convulsion. 3. After sublethal exposures coma may disappear promptly, but full recovery is usually slow; the patient may have a residual cough, cardiac dilatation , slow pulse, peripheral ... neuropathy, albumnuria and some degree of amnesia or of psychic disturbance. Recovery is eventually complete in most nonfatal cases. 4. Concentrations of 20-50 ppm irritates the eyes. Inhalation of 500 ppm for 30 minutes produces headache, dizziness, excitement, staggering, and gastroenteric disorders followed in some cases by bronchitis or bronchial pneumonia. Concentrations above 600 ppm can be fatal within 30 minutes through respiratory paralyses.
Overall Reference: HSDB® Hazardous Substances Data Bank HYDROGEN SULFIDE 7783064 Section 0 Administrative Information Hazardous Substances Databank Number: 576 Last Revision Date 20050624 Review Date Reviewed by SRP on 5/7/1998 1. Lewis, R.J. Sax's Dangerous Properties of Industrial Materials. 9th ed. Volumes 13. New York, NY: Van Nostrand Reinhold, 1996., p. 1843 2. Sullivan, J.B. Jr., G.R. Krieger (eds.). Hazardous Materials Toxicology Clinical Principles of Environmental Health. Baltimore, MD: Williams and Wilkins, 1992., p. 713 3. Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984., p. III200 4. Matheson; Guide to Safe Handling of Compressed Gases 2nd ED p.15 (1983)				
Dioxins	Burning of oil	Boat crews, rig workers	Large	1.
1. NIOSH; 2.				
Physical Agents:				
Heat stress	Heat	Beach crew, boat crews, rig workers	Large	1. A mild or moderate heat stress may cause discomfort and may adversely affect performance and safety. Heat strain – Sudden and severe fatigue, nausea, dizziness, or lightheadedness, disoriented, confused, inexplicable irritability, malaise, chills.
1. ACGIH – Heat Stress & Strain American Conference of Governmental Industrial Hygienists. Documentation of Threshold Limit Values for Chemical Substances and Physical Agents. Cincinnati, OH. 2007, p. 1, 4.				
Noise	Engines	Boat crews, Rig workers	Small-moderate	1. Noise is used to denote unwanted sound. 2. There are no visible effects, usually develops over a long period of time, and, except in

Agent	Source	Type of job	Number of Workers	Human health effects*
				very rare cases, there is no pain; progressive loss of communication, socialization, and responsiveness to the environment. 3. Hearing loss can be temporary or permanent. Chronic exposure to noise has a cumulative effect on hearing loss. The negative effects associated with long term hearing loss include: decreased ability or inability to communicate, irritability, tinnitus (ringing in the ears), and frustration with personal/familial relationships. Reported effects of noise, other than hearing loss, include fatigue, distraction, interference with speech, disturbed sleep, increased blood pressure, increased gastrointestinal mobility, peptic ulcer, changes in corticosteroid hormone levels, and dizziness. 4. Hearing loss; sleep disturbances; cardiovascular and psychophysiologic problems; performance reduction; annoyance responses; and adverse social behavior. These include noise-induced hearing impairment, interference with speech communication, and mental health effects.
1. ACGIH – Noise. American Conference of Governmental Industrial Hygienists. Documentation of Threshold Limit Values for Chemical Substances and Physical Agents. Cincinnati, OH. 2006, p. 2. 2. OSHA – Website: http://www.osha.gov/SLTC/noisehearingconservation/index.html 3. REPROTEXT® Database [Internet database]. Greenwood Village, Colo: Thomson Reuters (Healthcare) Inc. Updated periodically. 4. Berglund, B., T. Lindvall, and D. Schwela (eds) – World Health Organization. Guidelines for Community Noise. 1999. p.20				
Insecticides	Insecticide	Beach crew	Large	No information found on the specific type of insect repellant used.

*Information from the Hazardous Substances Data Bank (HSDB), a toxicology data file on the National Library of Medicine's (NLM), National Institute of Health (NIH), Toxicology Data Network (TOXNET®).